

THE DEVELOPMENT OF SOUND-SIGNAL PREFERENCES IN DUCKS

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IN an attempt to analyze one aspect of the ontogeny of behavior, a study was made of the manner in which young ducks and geese developed response tendencies directed toward specific sound-signals (Klopfer, 1957, and in press). It was found that the surface-nesting species which were studied (principally Mallards, *Anas platyrhynchos*, and Redheads, *Aythya americana*), if reared under conditions of relative auditory isolation, tended to approach most rhythmic, repetitive signals without discrimination. This behavior was not altered by intermittently exposing the birds to recordings of a particular signal at different ages before and after hatching. A specific response could be established, however, by presenting the sound while the bird was following a moving model or the experimenter. In at least one hole-nesting species, the Wood Duck (*Aix sponsa*), a different pattern was obtained. This species showed no tendency to approach rhythmic signals when the individuals tested were reared as auditory isolates, and this was also true for the birds which had been exposed to the moving experimenter plus a sound. Those birds which had been exposed to the sound alone, however, very rapidly developed a tendency to approach that sound to the exclusion of others. Individuals of a domestic strain of Muscovy Duck (*Cairina moschata*), which were largely nonvocal, could not be made to approach the sound signals irrespective of the treatment accorded. In all these instances the manner in which responses to auditory signals are established is related in a fairly simple way to the nesting habits and social organization of the different species. Of course, such a correlation does not in itself shed light on the causal relations, e.g., evolutionary development, of the traits in question.

In the present study I was concerned to re-examine one of the hypotheses of my previous work (*ibid.*). In particular, I wished to know whether the type of auditory imprinting shown by the Wood Duck would be shared by other hole-nesting species which are not members of the tribe Cairinini (Delacour and Mayr, 1945). For these purposes the Common Sheldrake (*Tadorna tadorna*, tribe Tadornini) was selected, for it was reasonably abundant locally and habitually nests in deep rabbit burrows.

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METHODS

The birds were arbitrarily distributed among three training groups which were treated as follows:

Isolates—Fifteen birds were incubated and hatched in an incubator situated within a sound-proof room (Thorpe and Hinde, 1956). These ducklings were kept in groups of 3 to 5 and heard no sounds other than those they themselves produced until the time at which testing took place, when the birds were between 18 and 26 hours of age.

Sound Only—Ten birds, from the moment of emergence until 10 to 14 hours of age, were exposed to a recorded sound-signal of three minutes' duration at intervals of one to two hours. The total time of exposure was 30 minutes. Each bird was exposed to one of two possible sounds: a slowly repeated monosyllabic *kom kom kom* or a more rapid and higher *pip pip pip*. Audiospectrographic analysis had previously shown that these two calls roughly resembled the two principal types of calls made by females of several tribes when leading young (Klopfer, 1957). These birds were tested 8 to 12 hours after the last exposure.

Following with Sound—Ten birds were allowed to follow the experimenter as soon as they proved able to walk, which was generally between 6 and 10 hours after emergence. At the same time they were exposed to one of the two sounds described above. Originally it was intended to have these birds follow a loudspeaker and model which were suspended from a pulley system, but the birds all proved to follow far more satisfactorily an articulated object such as the experimenter. Each following exercise took 5 to 10 minutes, with a maximum total of 30 minutes of exposure. A few good followers were exposed for only 20 minutes. Testing took place after an interval of 8 to 12 hours after the last exposure.

For the tests, the birds were individually introduced into a four-foot square box from each corner of which a smaller $6 \times 6 \times 12$ -inch box radiated. Each of the latter boxes had an opaque cover and, at the outer end, a loudspeaker. The central box had a black gauze cover so that, when lighted from within and placed in a darkened room, it was possible to observe the birds within without their being aware of the observer's presence. Sixty seconds after a bird had been introduced into the center of this apparatus, during which time it either sat quietly where it was placed or else wandered slowly about the central box, a sound signal was played through one of the speakers and the response of the bird noted. Although, on the basis of my earlier work, different types of responses were expected, the sheldrakes either went to the source of the sound within two minutes of its onset (and usually within 30 seconds, alternately emitting pleasure and distress notes, then entering the small box and pecking against its sides), or else they continued as they had been prior to the onset of the sound signal. In a few instances, the bird scurried quietly into one of

the boxes away from the sound source and crouched in a corner. This occurred a similar number of times before the onset of the sound signal. Whenever a bird had entered a small box, it was removed and replaced in the center of the apparatus before the next signal was presented.

The order in which the sounds were presented was systematically varied, as was the direction from which the sounds originated.

In addition to the sound signals described above, *kom* and *pip*, a disyllabic, slowly repeated *hel-lo* was also used, the pitch falling sharply from the first to the second syllable. This sound crudely mimics some of the more complex notes of male Wood Ducks, and species with similar whistled notes.

The previous experiments had demonstrated that during the period of a 30-minute test, changes in responsiveness were generally slight, as were the effects of experiences within the test apparatus. At that time, birds had been tested with a number of different sound-signals, including recordings of certain of the calls of various species of ducks and geese. In this instance, the lower temperatures which prevailed called for a significant reduction in the duration and number of the tests. As a consequence, the interpretation of the data must be qualified in certain ways (see below).

Ages were arbitrarily designated to be the number of hours elapsed from the moment of total emergence from the shell. This procedure is undoubtedly responsible for a certain amount of variability in the behavior of ducklings allegedly of similar ages, for the interval between the emergence of the first and last bird from a group of eggs incubated together was as great as 30 hours. As the eggs were collected before incubation had commenced and were then held at 40° F. for one to three weeks before being placed in the incubator, the actual developmental age of the first and last birds in such a hatch must differ widely, even though, one hour after emergence, both are considered to be "one hour old." Probably the temporal limits of the critical period for imprinting would be altered by an appropriate adjustment of the post-hatching age. Therefore, it would seem wise in the future for researchers to report with more precision the exact ages of ducklings under study.

RESULTS AND DISCUSSION

The general impression given by the 24-hour-old sheldrakes was that they were considerably less vocal than young Mallards, Redheads, and Wood Ducks. While these birds generally replied to the introduced sound-signals by emitting pleasure or distress notes, the sheldrakes did so far less frequently, and they did not appear to chatter among themselves so much. The fear response shown by isolates of 24 hours of age when first handled was also pronouncedly less severe than in these other species. It should be remarked that all of the sheldrakes used in these experiments required assistance in breaking through

the shell—possibly because the relative humidity within the incubator was not sufficiently high to prevent toughening and adhesion of the shell membranes. However, those birds which did survive appeared to be normally vigorous, and this assistance probably did not affect their behavior appreciably. Similar help had been given some of the birds from the earlier experiments, and apparently they did not differ from their normally-hatched siblings.

Of 88 freshly collected eggs, 19 were infertile, 8 contained dead embryos before 25 days of incubation, 19 embryos died after 25 days, and 6 hatched with severe intestinal prolapses. The results of trials with 35 of the remaining birds may be seen in Table 1.

TABLE 1
SOUND-SIGNAL RESPONSES OF 35 COMMON SHELDRAKE DUCKLINGS

Training Group	No. of Ducklings	Proportion of Ducklings Responding to Sound-signals			Total
		Kom	Hel-lo	Pip	
Isolates	15	none	1/15	1/15	2/15
Sound Only	10	0/7		2/3 ¹	2/10 ¹
Following with Sound	10	1/6 ¹		4/4 ¹	5/10 ¹

¹ Responded exclusively to sound to which they had been exposed.

It is more than moderately frustrating that the high mortality reduced the sample to a level where simple tests for significance cannot be applied. Certain comparisons with earlier data are possible, however. In the case of the Isolates among the Wood Ducks and Muscovy Ducks, 3/12 and 1/12, respectively, responded to one of the three sound signals (in addition to others), while among the surface-nesting ducks 12/12 responded. The confidence limits of these proportions do not overlap at the .05 level. Thus, it can be said that the sheldrakes, like the Cairinini studied, have no tendency to approach all rhythmic signals. The possibility that their responses are simply attuned to a narrower spectrum of sound, of course, cannot be eliminated, especially since so few test signals were used. But the difference from the surface-nesting birds remains.

Only 3/24 of the surface-nesters which had been members of the Sound Only group developed a specific response tendency directed exclusively toward the relevant signal, while the corresponding proportion for the Wood Ducks is 13/24. These proportions differ significantly at the .05 level. For the non-vocal Muscovy Ducks it is 0/18. The proportion for the sheldrakes is 2/10. In their seeming insusceptibility to auditory imprinting, the sheldrakes appear more like the other species than the Wood Duck.

Finally, in the Following with Sound group, 1/19 Muscovy Ducks, 1/24 Wood Ducks, but 16/25 surface-nesters developed a specific preference for the

relevant sound signal. Of the sheldrakes of this group 5/10 did the same, but it is striking that all five birds which were actually following the experimenter during the brief periods of exposure showed an extremely marked response to the relevant sound signals, and to these alone. Thus, while we cannot exclude the possibility that other sounds exist to which these birds would respond in the absence of visual and motor experience, it does appear that a preference can be established for sounds which are linked to a visual model. As in the surface-nesters, we may surmise that the following-response serves as a necessary reinforcement in the learning of particular sound-signals. This is decidedly not the pattern which was predicted for hole-nesting species, for whom auditory stimuli should be of greater importance than visual ones, and who should be either endowed with response tendencies directed to specific auditory stimuli at the time of hatching or else highly susceptible to auditory imprinting. This latter, for instance, seems to be true of the Wood Duck. We might thus suspect that newly hatched sheldrakes emerge from their burrows in response to visual or perhaps tactile stimuli, with auditory cues assuming a secondary importance.

SUMMARY

Thirty-five incubator-hatched Common Sheldrake (*Tadorna tadorna*) ducklings were tested for determination of type and degree of auditory imprinting. Fifteen of them were isolated in a sound-proof room where they heard no extraneous sounds. These showed little tendency to approach repetitive sound-signals. In this respect they were similar to Wood Ducks (*Aix sponsa*), and Muscovy Ducks (*Cairina moschata*), and unlike many species of surface-nesting waterfowl. Ten others of the young ducklings were exposed intermittently to recorded sound-signals which produced no change in their response patterns and in this respect sheldrakes were unlike Wood Ducks. Ten others were allowed to follow the experimenter while being exposed to the sound-signals. A highly specific preference for the sound was evident. This behavior was characteristic of several species of surface-nesting waterfowl.

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